

AMENDMENTS TO THE CLAIMS

The listing of the claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS:

1. (currently amended): A method for analyzing multivariate images, comprising:

- a) providing a data matrix \mathbf{D} containing measured spectral data,
- b) ~~transforming the data matrix \mathbf{D} , using a wavelet transform, applying~~
at least one wavelet transform to the data matrix \mathbf{D} to obtain a transformed data matrix $\tilde{\mathbf{D}}$ comprising an approximation matrix $\tilde{\mathbf{D}}_a$ and a detail matrix $\tilde{\mathbf{D}}_d$,
- e) ~~thresholding the wavelet coefficients of the transformed data matrix $\tilde{\mathbf{D}}$,~~
- d) ~~c) performing an image analysis on the transformed data matrix $\tilde{\mathbf{D}}$ to obtain a spatially compressed concentration matrix $\tilde{\mathbf{C}}$ and a approximation matrix $\tilde{\mathbf{D}}_a$ to obtain an approximation concentration matrix $\tilde{\mathbf{C}}_a$ and a spectral shapes matrix \mathbf{S} , and~~
- e) ~~d) computing a concentration matrix \mathbf{C} from the spatially compressed concentration matrix $\tilde{\mathbf{C}}$ approximation concentration matrix $\tilde{\mathbf{C}}_a$, the detail matrix $\tilde{\mathbf{D}}_d$, and the spectral shapes matrix \mathbf{S} .~~

2. (canceled)

3. (currently amended): The method of Claim 1, wherein the at least one wavelet transform comprises a Haar transform.

4. (canceled)

5. (canceled)

6. (currently amended): The method of Claim 1, wherein the image analysis of step d) ~~c)~~ comprises an alternating least squares analysis and the ~~spatially compressed concentration matrix $\tilde{\mathbf{C}}$~~ approximation concentration matrix $\tilde{\mathbf{C}}_a$ and

the spectral shapes matrix \mathbf{S} are obtained from a constrained least squares

solution of $\min_{\tilde{\mathbf{C}}, \mathbf{S}} \|\tilde{\mathbf{D}} - \tilde{\mathbf{C}}\mathbf{S}^T\|_F \quad \min_{\tilde{\mathbf{C}}_a} \|\tilde{\mathbf{D}}_a - \tilde{\mathbf{C}}_a\mathbf{S}^T\|_F$.

7. (currently amended): The method of Claim 6, wherein the alternating least squares analysis comprises a transformed non-negativity constraint $\tilde{\mathbf{C}}_a \geq 0$.

8. (currently amended): The method of Claim 1, wherein the computing step e) d) comprises:

computing a detail concentration matrix $\tilde{\mathbf{C}}_d$ from the detail matrix $\tilde{\mathbf{D}}_d$ and the spectral shapes matrix \mathbf{S} ;

combining the approximation concentration matrix $\tilde{\mathbf{C}}_a$ and the detail concentration matrix $\tilde{\mathbf{C}}_d$ to provide a transformed concentration matrix $\tilde{\mathbf{C}}$; and

applying an inverse wavelet transform to the spatially-compressed concentration matrix $\tilde{\mathbf{C}}$ to provide the concentration matrix \mathbf{C} .

9. (canceled)

10. (previously presented): A method for analyzing multivariate images, comprising:

- a) providing a data factor matrix **A** and a data factor matrix **B** obtained from a factorization of measured spectral data **D**,
- b) transforming the data factor matrix **A**, using a wavelet transform, to obtain a transformed data factor matrix $\tilde{\mathbf{A}}$,
- c) thresholding the wavelet coefficients of the transformed data factor matrix $\tilde{\mathbf{A}}$,
- d) performing an image analysis on the transformed data factor matrix $\tilde{\mathbf{A}}$ and data factor matrix **B** to obtain a spatially compressed concentration matrix $\tilde{\mathbf{C}}$ and a spectral shapes matrix **S**, and
- e) computing a concentration matrix **C** from the spatially compressed concentration matrix $\tilde{\mathbf{C}}$.

11. (previously presented): The method of Claim 10, wherein the data factor matrix **A** comprises a total of j blocks of data factors \mathbf{A}_i and the data factor matrix **B** comprises k blocks of data factors \mathbf{B}_i , thereby providing a concentration block \mathbf{C}_i in step e), and wherein steps a) through e) are repeated sequentially until the concentration matrix **C** is accumulated blockwise, according to

$$\mathbf{C} = [\mathbf{C}_1 \quad \mathbf{C}_2 \quad \cdots \quad \mathbf{C}_{j-1} \quad \mathbf{C}_j].$$

12. (original): The method of Claim 10, wherein the wavelet transform comprises a Haar transform.

13. (canceled)

14. (previously presented): The method of Claim 10, wherein the thresholding comprises decimating the detail coefficients.

15. (previously presented): The method of Claim 10, wherein the image analysis of step d) comprises an alternating least squares analysis and the spatially

compressed concentration matrix $\tilde{\mathbf{C}}$ and the spectral shapes matrix \mathbf{S} are obtained from a constrained least squares solution of $\min_{\tilde{\mathbf{C}}, \mathbf{S}} \|\tilde{\mathbf{A}}\mathbf{B}^T - \tilde{\mathbf{C}}\mathbf{S}^T\|_F$.

16. (original): The method of Claim 15, wherein the alternating least squares analysis comprises a transformed non-negativity constraint.

17. (previously presented): The method of Claim 10, wherein the computing step e) comprises applying an inverse wavelet transform to the spatially compressed concentration matrix $\tilde{\mathbf{C}}$ to provide the concentration matrix \mathbf{C} .

18. (previously presented): The method of Claim 10, wherein the computing step e) comprises projecting the product of the data factor matrix \mathbf{A} and the data factor matrix \mathbf{B} from step a) onto the spectral shapes matrix \mathbf{S} from step d), according to $\min_{\mathbf{C}} \|\mathbf{A}\mathbf{B}^T - \mathbf{C}\mathbf{S}^T\|_F$ and subject to appropriate constraints.

19. (original): The method of Claim 10, wherein the data factor matrix \mathbf{A} comprises a scores matrix \mathbf{T} and the data factor matrix \mathbf{B} comprises a loadings matrix \mathbf{P} , and wherein \mathbf{T} and \mathbf{P} are obtained from a principal components analysis of the measured spectral data \mathbf{D} , according to $\mathbf{D} = \mathbf{TP}^T$.

20. (original): The method of Claim 19, wherein \mathbf{T} and \mathbf{P} represent the significant components of the principal components.

21. (previously presented): The method of Claim 1, wherein the data matrix \mathbf{D} is weighted.

22. (previously presented): The method of Claim 10, wherein the data factor matrix \mathbf{A} and the data factor matrix \mathbf{B} are weighted.

23. (new): The method of Claim 1, wherein the wavelet transform applying step b) comprises:

folding the data matrix \mathbf{D} into a $(x+1)$ -dimensional multiway array $\underline{\mathbf{D}}$ consisting of x spatial dimensions and 1 spectral dimension comprising p spectral channels, wherein $x = 1, 2$, or 3 ;

applying an independent wavelet transform to each of the x spatial dimensions for each of the p spectral channels to provide a transformed multiway array $\tilde{\underline{\mathbf{D}}}$;

partitioning the transformed multiway array $\tilde{\underline{\mathbf{D}}}$ into a multiway approximation array $\tilde{\underline{\mathbf{D}}}_a$ and a multiway detail array $\tilde{\underline{\mathbf{D}}}_d$; and

unfolding the multiway approximation array $\tilde{\underline{\mathbf{D}}}_a$ to obtain the approximation matrix $\tilde{\mathbf{D}}_a$ and the detail matrix $\tilde{\mathbf{D}}_d$..

24. (new): The method of Claim 23, wherein the computing step d) comprises:

computing a detail concentration matrix $\tilde{\mathbf{C}}_d$ from the detail matrix $\tilde{\mathbf{D}}_d$ and the spectral shapes matrix \mathbf{S} ;

combining the approximation concentration matrix $\tilde{\mathbf{C}}_a$ and the detail concentration matrix $\tilde{\mathbf{C}}_d$ to provide a transformed concentration matrix $\tilde{\mathbf{C}}$;

folding the transformed concentration matrix $\tilde{\mathbf{C}}$ into an $(x+1)$ -dimensional transformed concentration matrix $\tilde{\underline{\mathbf{C}}}$;

applying an independent inverse wavelet transform to each of the x spatial dimensions of the transformed concentration array $\tilde{\underline{\mathbf{C}}}$ to obtain the multiway concentration array $\underline{\mathbf{C}}$; and

unfolding the multiway concentration array $\underline{\mathbf{C}}$ to obtain the concentration matrix \mathbf{C} .

25. (new): The method of Claim 1, wherein \mathbf{D} is a 2D data matrix comprising m rows and n columns and the wavelet transforms \mathbf{W} are applied according to

$$(\mathbf{W}_n \otimes \mathbf{W}_m) \times \mathbf{D} = \tilde{\mathbf{D}}.$$

26. (new): A method for analyzing multivariate images, comprising:

- a) providing a data matrix \mathbf{D} containing measured spectral data,
- b) applying at least one wavelet transform to the data matrix \mathbf{D} to

obtain a transformed data matrix $\tilde{\mathbf{D}}$ comprising an approximation matrix $\tilde{\mathbf{D}}_a$,

- c) performing an image analysis on the approximation matrix $\tilde{\mathbf{D}}_a$ to obtain a spectral shapes matrix \mathbf{S} , and
- d) computing a concentration matrix \mathbf{C} from the data matrix \mathbf{D} , and the spectral shapes matrix \mathbf{S} .

27. (new): The method of Claim 26, wherein the at least one wavelet transform comprises a Haar transform.

28. (new): The method of Claim 26, wherein the image analysis of step c) comprises an alternating least squares analysis and an approximation concentration matrix $\tilde{\mathbf{C}}_a$ and the spectral shapes matrix \mathbf{S} are obtained from a constrained least squares solution of $\min \|\tilde{\mathbf{D}}_a - \tilde{\mathbf{C}}_a \mathbf{S}^T\|_F$.

29. (new): The method of Claim 28, wherein the alternating least squares analysis comprises a transformed non-negativity constraint $\tilde{\mathbf{C}}_a \geq 0$.

30. (new): The method of Claim 26, wherein the computing step d) comprises projecting the data matrix \mathbf{D} from step a) onto the spectral shapes matrix \mathbf{S} from step c), according to $\min_c \|\mathbf{D} - \mathbf{C} \mathbf{S}^T\|_F$, subject to constraints.

31. (new): The method of Claim 26, wherein the wavelet transforms applying step b) comprises:

folding the data matrix \mathbf{D} into a $(x+1)$ -dimensional multiway array $\underline{\mathbf{D}}$ consisting of x spatial dimensions and 1 spectral dimension comprising p spectral channels, wherein $x = 1, 2$, or 3 ;

applying an independent wavelet transform to each of the x spatial dimensions for each of the p spectral channels to provide a transformed multiway array $\tilde{\underline{\mathbf{D}}}$;

decimating the detail coefficients of the transformed multiway array $\tilde{\underline{\mathbf{D}}}$ to obtain a multiway approximation array $\tilde{\underline{\mathbf{D}}}_a$; and

unfolding the multiway approximation array $\tilde{\underline{\mathbf{D}}}_a$ to obtain the approximation matrix $\tilde{\mathbf{D}}_a$.